



**COMMANDER'S GUIDE
TO ANTICIPATING ENVIRONMENTAL SIDE EFFECTS FROM
RENEWABLE ENERGY DEVELOPMENT**

**ABERDEEN TEST CENTER
DUGWAY PROVING GROUND
REAGAN TEST SITE
WHITE SANDS MISSILE RANGE
YUMA PROVING GROUND**

**NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT
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PACIFIC MISSILE RANGE FACILITY**

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45TH SPACE WING
96TH TEST WING
412TH TEST WING
ARNOLD ENGINEERING DEVELOPMENT COMPLEX**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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SPECIAL REPORT

COMMANDER'S GUIDE TO ANTICIPATING ENVIRONMENTAL SIDE EFFECTS FROM RENEWABLE ENERGY DEVELOPMENT

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Preface

This special report presents the results of Task SEG-001, “*Commander's Guide – Anticipating Environmental Side Effects from Renewable Energy Development.*” The report was produced by the Sustainability and Environmental Group (SEG) of the Range Commanders Council (RCC). Discussed herein is a series of questions designed to address the potential environmental side effects from development of renewable energy (RE) projects in each range's area of influence. This guide does not address operational mission impacts of RE, which is documented in the RCC document “*Commander's Guide to Renewable Energy.*”¹ Additionally, this guide does not address the primary environmental impacts of RE development, which should be addressed by the Environmental Assessment (EA) for the project. This guide will assist commanders in identifying the side effects of RE development on their environmental footprint. It provides a playbook to identify potential issues and recommend solutions.

The report will provide member ranges with information and tools to recognize in advance the potential environmental side effects from RE development.

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¹ Range Commanders Council. Commander's Guide to Renewable Energy. RCC Special Report. August 2011. Available at http://www.wsmr.army.mil/RCCsite/Documents/Commanders%20Guides/CG_%20Renewable%20Energy.pdf.

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Acronyms

CPLO	Community Planning Liaison Officer
CSP	concentrating solar thermal plant
DoD	Department of Defense
EA	Environmental Assessment
EIS	Environmental Impact Statement
HTF	heat transfer fluid
JLUS	Joint Land Use Study
MW	megawatt
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
PV	photovoltaic
RCC	Range Commanders Council
RE	renewable energy
RTE	rare, threatened, endangered
SG	Sustainability Group
SEG	Sustainability and Environmental Group
U.S.	United States

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CHAPTER 1

Background

1.1 Introduction

Sources of RE are essential to the nation; however, RE located on or off Department of Defense (DoD) land and water has the potential for environmental side effects that could impact the military mission. Installation and range commanders, major commands, fleets, and their staffs must take steps to become aware of pending projects so they can apply this guide to determine if those projects will cause environmental side effects to the military mission in the future.

Primary environmental impacts from RE development projects should be discussed in a National Environmental Policy Act (NEPA) document, such as an EA or Environmental Impact Statement (EIS). Other environmental studies, such as an environmental impact analysis, may be available through the local permitting process. Though these documents consider the direct environmental impacts of RE development and operation, they may not consider the possible environmental side effects to the surrounding areas. Likewise, this guide will not address the operational impacts to the military mission from RE, as those impacts have been studied previously in the *“Commander's Guide to Renewable Energy”* provided by the Sustainability Group (SG). Further, operational impacts are considered through the DoD Siting Clearinghouse. The possible impacts from transmission lines are not considered in this guide, though there are potential effects to the military mission from the lines. An analysis of transmission line impacts, both technically and environmentally, could be the topic of a future Commander's Guide.

This Commander's Guide is intended to fill two roles: as a playbook for installation and range leaders to anticipate potential environmental side effects; and as a set of solutions for addressing those unintended and possibly unknown issues. The guide is structured to provide a process for identifying and anticipating possible environmental side effects and culminates with some possible tools to help address those concerns. [Appendix A](#) contains a flow chart that can be used to accompany the thought process provided in this guide. [Appendix B](#) contains some topics to provoke thought for specific kinds of RE development.

1.2 Range Commanders Council Sustainability and Environmental Group

The mission of the RCC is to serve “the technical and operational needs of the United States (U.S.) test, training, and operational ranges.” The SEG, one of many RCC workgroups, was formed in 2012 when the SG and Range Environmental Group were merged. The SEG's goal is to monitor and address sustainability, encroachment, environmental, and community outreach issues affecting the test, training, and operational ranges.

The SEG meets twice a year for two purposes: to review and discuss the latest issues affecting the ability of member ranges to sustain their missions; and to share tools for proactively addressing those concerns. The SEG focuses on environmental management and compliance, land use, outreach, air and sea space encroachment, and other sustainability areas. The SEG shares trends and approaches used to protect the military mission and recommends solutions to commanders.

Meetings are interactive and open to ranges and installations throughout the U.S. and are not limited to Major Range and Test Facility Base installations. Entities both inside and outside the DoD with common interests in environmental, sustainability, encroachment, and community outreach solutions are welcome to attend.

1.3 Previous Commander's Guides

Prior to the group merger, the SG produced a number of primers related to RE and community involvement. This primer continues that series and discusses the potentially unforeseen environmental considerations associated with RE.

1.3.1 Commander's Guide to Community Involvement²

This Commander's Guide discusses the need to proactively work with the civilian communities, government organizations, media, and others to preclude adverse impacts of encroachment on the military's ability to test, train, and operate.

1.3.2 Commander's Guide to Renewable Energy

This Commander's Guide discusses the mission impacts by RE infrastructure projects and the technical and operational issues associated with RE projects.

1.3.3 Commander's Guide - Overview of State Legislative and Administrative Actions³

This Commander's Guide was developed to provide the military a brief overview analysis of state legislative and administrative information, circa 2005, that is available on the DoD Environment, Safety and Occupational Health Network and Information Exchange website (<http://www.denix.osd.mil>). The information contained 50 state summary documents arranged in nine categories to show proactive approaches states have taken to address military sustainability.

1.3.4 Commander's Guide - Best Practices and Lessons Learned⁴

This Commander's Guide describes successes of installations and ranges in effectively dealing with sustainability issues.

² Range Commanders Council. Commander's Guide to Community Involvement. RCC Special Report. February 2006. Available at

http://www.wsmr.army.mil/RCCsite/Documents/Commanders%20Guides/CG_Community%20Involvement.pdf.

³ Range Commanders Council. Commander's Guide - Overview of State Legislative and Administrative Actions. RCC Special Report. December 2005. Available at

http://www.wsmr.army.mil/RCCsite/Documents/Commanders%20Guides/CG_overview.pdf.

⁴ Range Commanders Council. Commander's Guide - Best Practices and Lessons Learned. RCC Special Report. February 2006. Available at

http://www.wsmr.army.mil/RCCsite/Documents/Commanders%20Guides/CG_Best%20Practices.pdf.

CHAPTER 2

Identify the Mission Footprint

2.1 Define Area of Influence

The area of influence for the military mission is more than just the installation boundary, defined maneuver corridor, or direct area of operation. It is your area of potential effect that includes any and all land, water, air, and space, used for:

- Travel through, over, or under;
- Transit to and from the mission space;
- Frequency footprint and areas that could impact frequency;
- Instrumented military training routes;
- Visual military training routes;
- Slow speed/low altitude training routes;
- Military special use air space;
- Operational noise contours;
- Line of sight;
- Air, sea, and land space to conduct mission, including surface danger zone buffers and restricted air and water space;
- All other areas that are either required to conduct the mission or are impacted by the mission.

The area of influence drives the scope of potential environmental side effects. A change to this environmental footprint will have an impact on mission operations.

2.2 Sources to Help Identify the Area of Influence

In order to identify the area of influence, range commanders should consult with staff from Range Operations, Environmental, Sustainability, and Encroachment. These staff entities will be able to identify the entire region from which an environmental side effect could impact the military mission.

In addition to staff, range commanders can consult the Joint Land Use Study (JLUS), if there is one for the installation. The JLUS is a joint planning document incorporating the military installation and surrounding communities that interact with that military mission.

Other tools that can be useful include the Mission Compatibility Analysis Tool and Air Force Installation Complex Encroachment Management Action Plan.

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CHAPTER 3

Identify Environmental Pinch Points

3.1 Identify Current Environmental Pinch Points

What is the current level of exposure that your mission has to environmental regulation or environmental concerns? What are the specific requirements of that exposure, such as requirements from permits, biological opinions, regulations, policies, or other agreements? What are the conditions necessary to support those environmental concerns?

For instance, if you have a rare, threatened, endangered (RTE) species, identify the natural resources and ecosystem conditions necessary to sustain that species. If you have an issue with air emission non-attainment, identify the levels of the emission in your local area as compared to the regulatory limits. If you have water quality or quantity concerns, identify what your water rights are and/or what drought conditions exist. Identify what your waste streams are and what the costs of disposal currently are in your region. Identify any land use restrictions. Identify cultural resources. Identify all the natural resources on your base. Identify your exposure to climate change.

3.2 Identify Potential Future Environmental Pinch Points

Potential future environmental concerns are present in many forms. There may be existing regulations under revision to include more stringent requirements. Perhaps there are new proposals to regulate an environmental media that is currently unregulated in your area. In the case of RTE or other species, there may be species in your region that don't currently exist on your installation or haven't yet been found on your installation. Maybe your region is close to being regulated for certain types of environmental media, such as water, air, or waste.

Leveraging relationships with current regulators, JLUS partners, or other industry partners can help you identify what your potential future environmental pinch points could be.

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CHAPTER 4

Intersection of Environmental Concerns and Renewable Energy Impacts

4.1 Identify Type of Renewable Energy

Identifying the potential for RE in your location is the first step. The National Renewable Energy Laboratory (NREL) website, www.nrel.gov, provides overview maps by state and by RE technology potential. Use these resources to identify the types of RE that are feasible in your area.

Each type of RE comes with a different set of environmental impacts and side effects. [Appendix B](#) provides a list of some common types of RE and environmental considerations for each specific type. Use [Appendix B](#) as a guide when identifying the environmental impacts from RE development in your area and when reviewing environmental documentation, such as NEPA, pertaining to that development.

Leveraging existing relationships with JLUS partners or other community interaction through the Community Planning Liaison Officer (CPLO) can provide early indication of pending development. Monitoring the local government planning and zoning proceedings is also a good source.

If the RE development has generated any environmental planning documents, such as an EA or EIS, use those documents to identify the primary environmental impacts and help lead you to the potential environmental side effects. Use the public comment period that is required for these documents to formally register any concerns with the environmental impacts of the project, regardless of whether they are primary impacts or potential side effects.

4.2 Determine if RE Development Will Impact Your Environmental Pinch Points

Based off the review of your specific current and future environmental concerns and the environmental impacts of the RE development project, determine if there will be intersection. This step can be as simple as listing the concerns/impacts side by side and looking for commonality.

4.2.1 No Commonality, Now What

If the review of your environmental concerns and the RE development impacts yields no common problems, then you most likely have a mutually beneficial RE project from an environmental perspective. That is a great result, but still requires environmental management. Be sure to continue to monitor your environmental posture and the impacts of the RE project, and be prepared to engage if necessary.

4.2.2 Potential Problem, What To Do

If the review of your environmental concerns and the RE development impacts does yield a potential side effect, the concerns can be mitigated if you engage early. Ensure that there is an open pathway for your staff to notify the chain of command and discuss those concerns early.

After discussing the findings with the chain of command, be sure to have a unified course of action for engaging stakeholders to solve the problem. All stops along the chain of command

should have the same message going out to stakeholders. Developing a communication plan with your Public Affairs Officer or CPLO could be beneficial. Be sure to include your Environmental Officer, Sustainability Officer, and other staff offices that can help develop the communication plan and engage stakeholders. The message must be based on data, or on reasonable assumptions when data is limited or unavailable. Using the doomsday approach will not work if the position is not defensible or the message isn't consistent.

Once there is a unified message, you should engage stakeholders as early as possible. Stakeholders will include pertinent regulatory agencies and the RE developer, at a minimum. Staff offices can help identify the stakeholders. Raise and document concerns early in the NEPA process for the development project. Again, ensure these concerns are consistent with the communication plan.

It is possible to work toward agreeable solutions if the developer and regulators are engaged early in the process. When engaged early, mitigating factors can be designed into the development process versus being retrofitted into the process.

If there is no possible solution, it is possible to engage regulators to obtain regulatory relief to avoid future environmental impacts to mission. Again, this must take place early in the development process so that it is clear to the regulator that you are seeking relief for actions that can potentially occur. Once the potential side effect becomes an actual environmental issue, it is too late to seek regulatory relief.

CHAPTER 5

Resources

This chapter contains a list of resources that can help you both identify potential concerns and also help resolve those concerns once they are identified.

5.1 People

Many of the resources needed to evaluate and resolve potential issues already exist within staff elements.

Environmental Officer: The staff environmental officer will have an understanding of the environmental pinch points for the installation. They will also be familiar with the plethora of regulatory processes needed to evaluate the issues.

Encroachment or Sustainability Officer: The staff sustainability officer will have an understanding of how different RE development can encroach upon the military mission.

Community Planning and Liaison Officer: The Navy employs regional CPLOs to interact with the community and understand the relationship that exists between the military and surrounding communities.

Range Operations Officer: The operator will have an understanding of the impacts to an encroachment on their ability to conduct test, training, and operational missions. Using this insight, a determination can be made on how environmental side effects from RE will impact their ability to conduct their mission.

Public Affairs Officer: The public affairs officer maintains the contacts with local and national media and other outreach venues. They can assist in developing a unified communication plan to reach out to the different stakeholders.

5.2 Plans

Many installations already possess a number of planning documents that can assist in identifying encroachment issues and resolving environmental conflicts.

Joint Land Use Study: The JLUS is a regional planning tool that helps communities and the military identify means to improve the relationship and reduce encroachment on all stakeholders. There may be recommendations or relationships created through the JLUS that can assist in resolving any conflicts.

RCC Commander's Guides: The predecessor to the SEG, the RCC SG, produced a number of Commander's Guides that can assist in understanding RE technologies and community involvement.

The *Commander's Guide to Renewable Energy* provides good information on the technical side of RE development and mission impacts that can be caused by RE. This guide is a good resource for the operational impacts.

The *Commander's Guide to Community Involvement* provides a number of good strategies for engaging the community, as well as a number of existing organizations that can be consulted. This guide is a good resource when engaging other stakeholders will be necessary due to environmental conflicts.

Other Local Plans: In addition to the plans and guides listed above, there is a number of local plans that may exist for your range location. The installation master plan can help identify on-base conflicts and master planners may have relationships with their counterparts in the community. The base may have an Air Installation Compatible Use Zone study that can assist with identifying encroachment issues.

5.3 Other Useful Resources

Range Commanders Council Sustainability and Environmental Group: The SEG is a valuable resource for commanders to reference to assess potential environmental considerations as well as mission impact.

National Renewable Energy Laboratory: The NREL website, www.nrel.gov, is a useful tool for understanding the RE potential in your area and better understanding the different types of RE technologies on the market. The site also contains a number of environmental planning documents related to RE development around the country.

CHAPTER 6

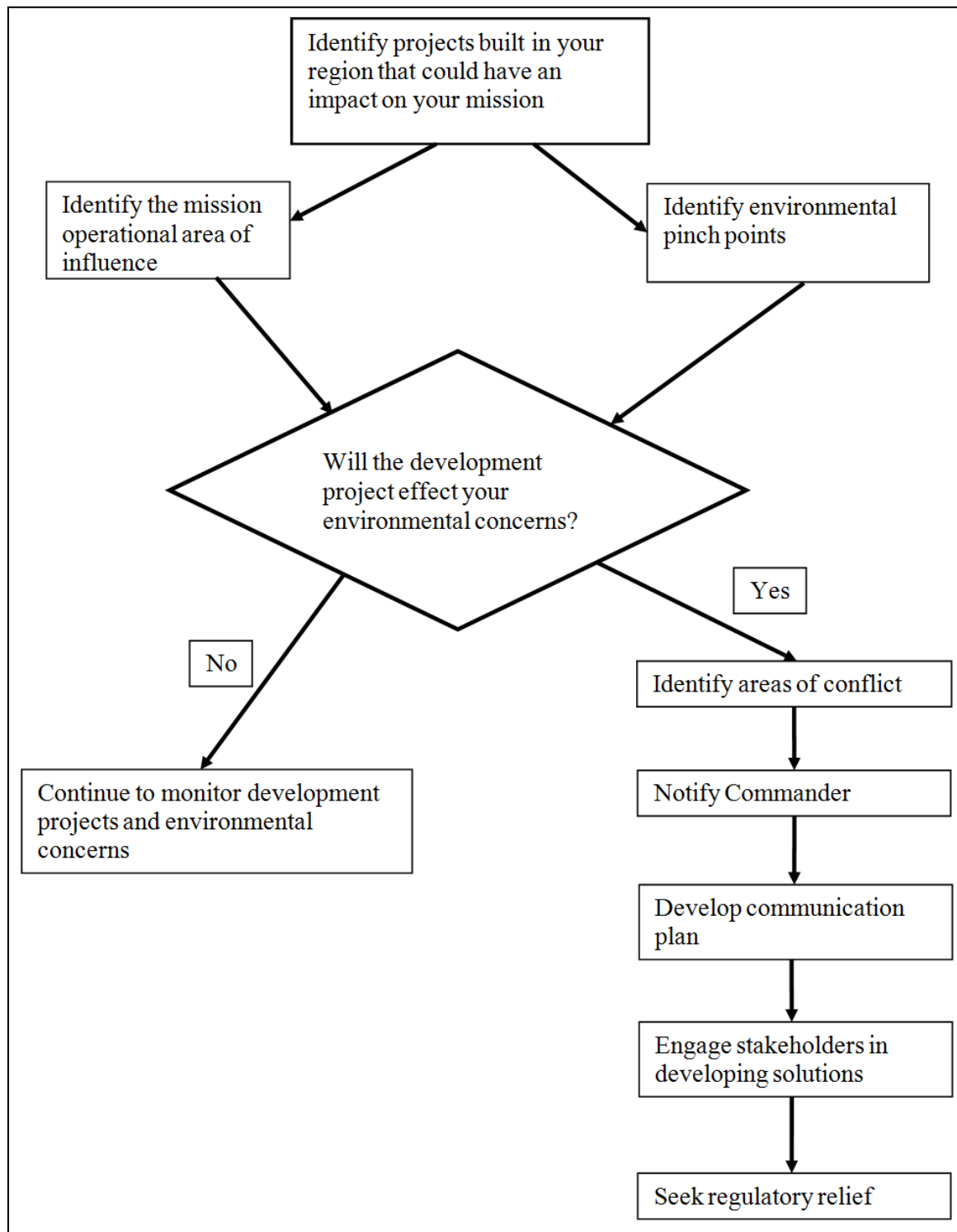
Summary

Range commanders need to consider potential environmental side effects of RE development. Understanding these side effects can help range commanders better develop solutions for ensuring that the military mission can continue and still support the nation's need to identify RE sources. By considering potential environmental side effects of RE development and combining that analysis with the operational and technical considerations previously analyzed, a complete assessment of mission impacts can be accomplished.

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Appendix A

Decision-Making Flow Chart



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Appendix B

Considerations for Specific Renewable Energy Technologies

B.1 Photovoltaic Solar

Air Considerations:

- A likely impact is a temporary increase in emissions from airborne dust during the construction phase. Short-term emissions are from increased vehicle pollutants and dust particulates from clearing and grading.
- Will the disturbed area be re-seeded after construction? If not, will it create a possible dust issue?
- In the long run, air quality can get better due to less fossil fuel use.

Water Considerations:

- Due to the large land area required for solar farms, a hard look at the streams, surface waters, groundwater, floodplain maps, wetlands, and storm water flows needs to be considered.
- Storm water pollution prevention plans will need to be written. Erosion and sediment controls will need to be put into place.

Waste Considerations:

- The photovoltaic (PV) panels are sealed under normal operating conditions, but can contain hazardous materials inside the panels. A panel could be damaged or break and the hazardous materials would need to be contained and disposed of in accordance with local, state, and federal regulations.

Natural Resource Considerations:

- Vegetation, wildlife, migratory birds, threatened and endangered species, sensitive species, and species of concern could be affected. This resource is highly dependent on the specific site location.
- Degradation may take place due to the large land area that is needed for PV. Is there potential for impacts to mission environmental pinch points due to degradation of regional natural resources?
- Land clearing, excavation, and construction would disturb site vegetation. Noxious weeds may invade the area that was cleared. Permanent loss of native vegetation can take place. Loss of the topsoil while clearing and grading can impact the way the area grows back.
- Due to the loss of vegetation, birds, migratory birds, bird nests, small mammals, other land-based animals, and species that forage could be affected. Site-specific surveys would need to be conducted to determine what types of wildlife would be affected. Does the mission space have suitable habitat that displaced species

could migrate to? Will the way species are managed regionally change? If so, will it impact the range?

Cultural Resource Considerations:

- Cultural resources include both archaeological sites and historic properties. Both would be addressed under the National Historic Preservation Act (NHPA), as amended.⁵ This could also include properties that are important to the local community. Each location chosen for a solar farm will need to have site-specific cultural surveys performed if not already done. Decisions should be made on whether or not the land use will have adverse impacts on cultural resources.

Other Considerations:

- Land use, including visual resources, is one of the main environmental impacts with PV technology. It is estimated that PV can use up to 3-10 acres per megawatt (MW). The land use category will change considerably and the view shed will change dramatically.

B.2 Concentrating Solar Power and Power Towers

This section covers environmental effects by concentrating solar thermal plants (CSP), which can include parabolic troughs, parabolic dish, and solar power tower.

Air Considerations:

- A likely impact is a temporary increase in emissions from airborne dust during the construction phase.
- Electric-generating equipment may need to be permitted. Even though there is a long-term beneficial impact to air quality (solar vs. fossil fuels), there would still be emissions associated with the equipment generating the electricity from the heat.
- Hazardous air pollutants could increase depending on the type of transfer fluid used.
- Limiting the disturbance can help with the airborne dust.

Water Considerations:

- A CSP system can use water to cool as well as create steam to produce energy by either a steam turbine generator or a generator.
- Parabolic trough and solar power tower CSP systems typically use a heat transfer fluid (HTF) like synthetic oil. A power tower can also use molten salt as the HTF but water is still required to produce steam.
- Depending on the size of the CSP systems there could be large quantities of the HTF on site (see hazardous materials section).

⁵ National Historic Preservation Act of 1966, as amended, 16 U.S.C. § 470 et. seq. (last amended 2014)

- Estimated water usage for a typical parabolic trough and power tower solar system is 800 gal/h/MW.⁶ This includes both mirror washing and cooling. Recirculating wet-cooling systems use the most water. Other systems used are a dry-cooling system, or a wet-dry system. Either method used needs to be analyzed for water usage and the effects to your specific area.
- Maintain cognizance of the latest technologies, as different technologies use water differently. For instance, an organic Rankine cycle turbine boils an organic working fluid in a closed-loop system to drive the turbine generator. This uses significantly less water and other technologies are coming online that need a hard look to determine their water usage.
- Due to the large land area required for solar farms, a hard look at the streams, surface waters, groundwater, floodplain maps, wetlands, and storm water flows needs to be considered. Storm water pollution prevention plans will need to be written and erosion and sediment controls will need to be put into place.

Waste Considerations:

- The CSP systems could have additional hazardous materials on site. Synthetic oils for the HTF or molten salt, such as sodium nitrate and potassium nitrate, may be used.
- Synthetic oils could be a mixture of biphenyl and biphenyl oxide for the steam heat exchanger.
- Volumes of HTF could be over a million gallons depending on the size of the CSP.
- Diesel for generators may be stored and could range from 500 - 2000 gallons.
- Hydraulic fluid, transmission oil, and glycol-based coolants could be used on site.

Natural Resource Considerations:

- The large land area required could affect natural resources. Vegetation, wildlife, migratory birds, threatened and endangered species, sensitive species, and species of concern could be affected due to the large disturbed area. This resource is highly dependent on the specific site location. This is an area where direct, secondary, and cumulative impacts could be impacted.
- Land clearing, excavation, and construction would disturb site vegetation. Noxious weeds may invade the area that was cleared. Permanent loss of native vegetation can take place. Loss of the topsoil while clearing and grading can impact the way the area grows back.
- Due to the loss of vegetation, birds, migratory birds, bird nests, small mammals, other land-based animals, and species that forage could be affected. Site-specific

⁶ Bureau of Land Management and U.S. Department of Energy. Final Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States (Arizona, California, Colorado, Nevada, New Mexico and Utah), FES 12-24; DOE/EIS-0403; 2012.

surveys would need to be conducted to determine what types of wildlife would be affected. Consider where these animals may move if they are displaced.

Cultural Resource Considerations:

- Cultural resources include both archaeological sites and historic properties. Both would be addressed under the NHPA.
- These considerations could also include properties that are important to the local community. Each location chosen for CSP will need to have site-specific cultural surveys performed. Decisions should be made on whether or not the land use will have adverse impacts on cultural resources.

Other Considerations:

- Land use, including visual resources, is one of the main environmental impacts with CSP technology. It is estimated that CSP can use between 4 and 16 acres per MW (BLM/DOE 2012). The land use category will change considerably and the view shed will change dramatically.

B.3 Wind

Air Considerations:

- The main concern will be air quality for PM10 and PM2.5 if the construction site is not kept to a minimum of bare earth. Is there any potential for dust emissions?

Water Considerations:

- Surveys should be performed to identify surface waters, wetlands, storm water drainage, floodplains, and other sources of water.
- If there are water sources, will there be an increase to the waterfowl population, and could that have an impact?

Waste Considerations:

- Waste considerations are generally minimal, outside of standard use of petroleum, oil, and lubricant products for typical operation.

Natural Resource Considerations:

- What is the potential for collisions by birds? Have there been enough studies/surveys done to determine existing nest, roost, and feeding sites, as well as migration and flight paths?
- What is the potential for impacts to bats? Have surveys been done to identify existing bat roosts? Migrating bats make up most of the fatalities associated with wind energy facilities.

- Is the project following the US Fish and Wildlife Service Eagle Conservation Plan Guidance, Land-Based Wind Energy, most current version?
- Is a take permit being issued for the project? If so, are there ramifications for take permits throughout the region? Will this impact your ability to get a take permit in the future for mission needs?
- Are there mitigation strategies for natural resources built into the design plans? Should there be?
- Land surface impacts will exist as a result of construction.

Cultural Resource Considerations:

- Has there been an archaeological survey conducted? What were the results?

Other Considerations:

- Regarding transportation, there will be an increase in traffic, including oversized loads and slow moving equipment, during construction. Will that have an impact?
- Regarding visual resources, has there been a view shed analysis done? Should one be conducted? Are there impacts to sensitive landscapes or historical settings?

B.4 Geothermal

Air Considerations:

- If on DoD lands, then close coordination with local air district jurisdictions and permitting will be required. Will permit conditions impact mission?
- If not on DoD lands, then there are no direct DoD permit requirements. Coordinate with local air district jurisdictions to ensure no change to mission area.
- Significant air emissions can include releases of dangerous levels of hydrogen sulfide from associated geothermal production.

Water Considerations:

- Water use associated with geothermal operations can affect both groundwater quality and available aquifer quantity both on and off DoD lands.
- Additional side effects from groundwater pumping can include changes to surface landscapes and topographical conditions. These changes may have a negative impact to wildlife habitat, create ground subsidence, accelerate desertification, etc.

Waste Considerations:

- If on DoD lands, then close coordination with local waste management jurisdictions and permitting may or may not be required.
- If not on DoD lands, then there are no direct DoD waste management requirements. Will the additional load on the waste management facility impact the range's use of that facility?

Natural Resource Considerations:

- If on DoD lands, effects to managed species and their habitats could occur from the development of geothermal plants on previously undisturbed lands.
- If located off DoD lands, those effects can still impact DoD managed species in the adjoining vicinity. Where will the species go? Coordination with state and federal agencies may be required.

Cultural Resource Considerations:

- If on DoD lands, effects to cultural resources could occur from the development of geothermal plants on previously undisturbed lands.
- Other concerns regarding the identification of Traditional Cultural Properties (TCP) via a consultation process with indigenous groups may be required.
- Coordination with state and federal agencies regarding cultural resources and/or TCP's may be required.

Other Considerations:

- Other considerations are dependent on site-specific locations and conditions.
- These considerations may include socio-economic/environmental justice considerations.

Models or additional information for support:

- Navy Geothermal Program Office, U.S. Navy. Point of contact: Dr. Andrew Sabin. (719) 373-3531. andrew.sabin@navy.mil.

B.5 Wave

Air Considerations:

- Air quality impacts from wave energy projects would be limited to those created by temporary increases in ship traffic during construction and potential increases in ongoing ship traffic for ongoing operations/maintenance. Will the increased ship traffic cause a concern?
- The technology itself is unlikely to have any direct air quality impacts.

Water Considerations:

- Wave energy projects are unlikely to significantly impact water quality.
- There is a very limited potential for temporary impacts during construction/installation due to increases in turbidity.
- The potential exists for chemical effects from sources that include toxins from antifouling paints or metals including lead and zinc, and organics, such as those found in hydraulic fluids.

Waste Considerations:

- No known waste considerations at this time.

Natural Resource Considerations:

- Natural resource impacts are the single highest area of potential concern for wave energy projects.
- Impacts could include direct takes of seafloor organisms during installation, biological sensitivities to electrical, magnetic, and acoustic transmissions, ecological consequences from the fouling community on hard structures, risk of collision, or entrapment of animals and impairment of the ability for sea turtles, whales, and other animals to feed or migrate.
- Significant emphasis should be placed on analyzing the potential impacts to these resources and the need to prepare Essential Fish Habitat Assessments along with any Marine Mammal Protection Act or Endangered Species Act consultations. Could the project alter feeding or migration patterns?
- The removal of energy from the wave train may create alterations in current and sediment transportation. Could alterations in current change feeding or migration patterns?

Cultural Resource Considerations:

- It is unlikely that wave energy projects would have impacts on offshore cultural resources (e.g., shipwrecks) but care should be taken to ensure the proposed project area does not overlay such resources.
- New onshore infrastructure could have impacts on historic resources and should be analyzed.

Other Considerations:

- The use of new or existing infrastructure to transmit wave energy to shore-side facilities should be considered.
- New infrastructure could require significant additional review for both natural resource impacts and various required permits from state, federal, and local agencies.

Models or additional information for support:

- Few, if any, models exist in the U.S.
- Examples of test projects from other countries exist.

B.6 Biomass

Air Considerations:

- High-temperature exhaust plumes may cause significant air disturbances such as turbulence and vertical shear.
- Particulate from biomass will require scrubbing. Air permits will be required.

Water Considerations:

- Will the plant impact water quality or quantity in the region?
- Permits for operation and use may be required.

Waste Considerations:

- What are the uses for the fly ash? Will it be disposed or reused?
- Will the bottom ash be disposed or reused?

Natural Resource Considerations:

- What is the feedstock for the plant?
- Where does the feedstock come from?
- How much supply is available, and where will the supply come from after that availability?
- What are the impacts to the ecosystem from harvesting the feedstock?
- Does the change in the ground cover impact any animal habitat and if so, what are the potential impacts?

Cultural Resource Considerations:

- Standard cultural resource surveys should be performed.

Other Considerations:

- No additional environmental considerations are known at this time.

Appendix C

Citations

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